Requirements for the MPD muon system.

DUNE ND Workshop
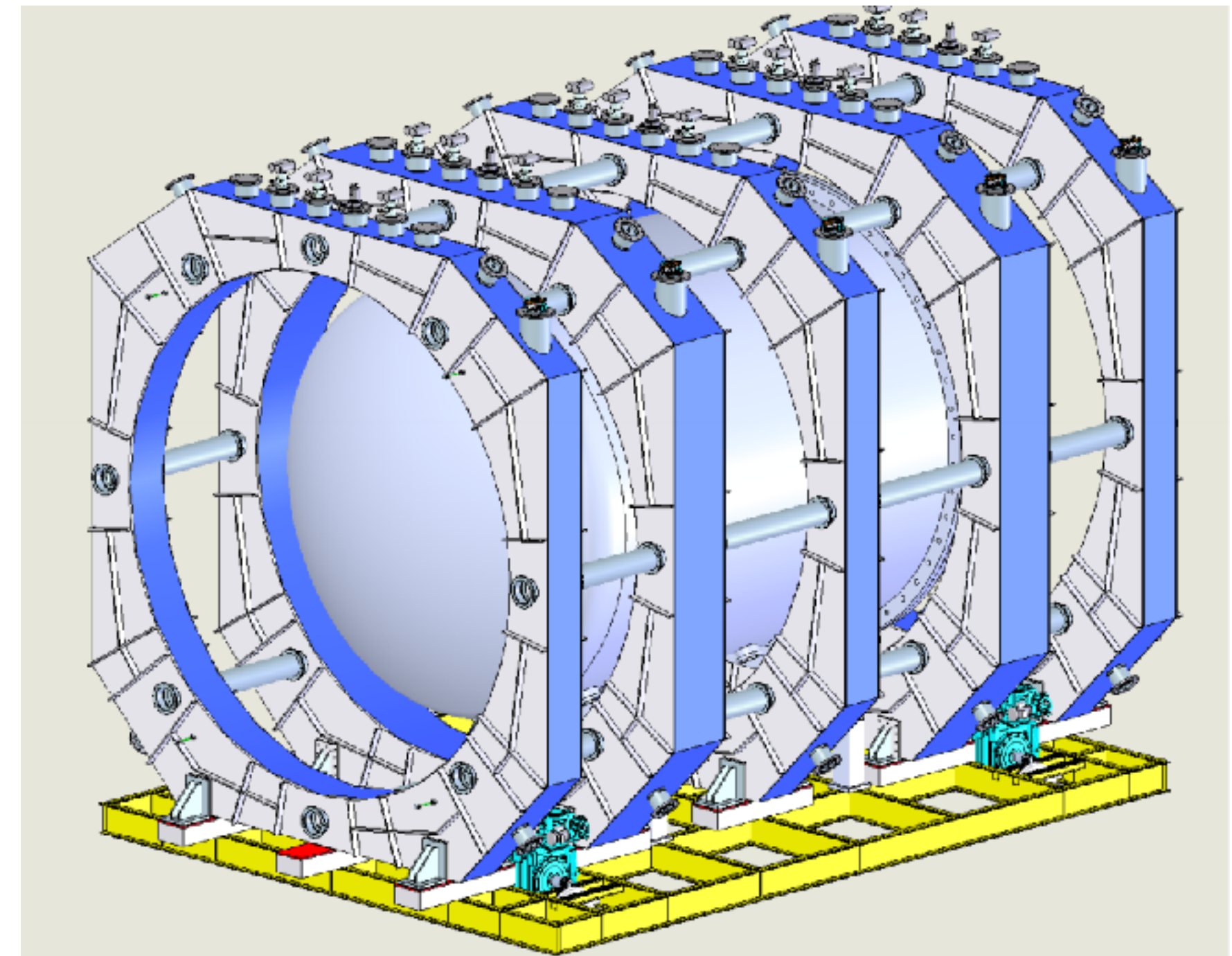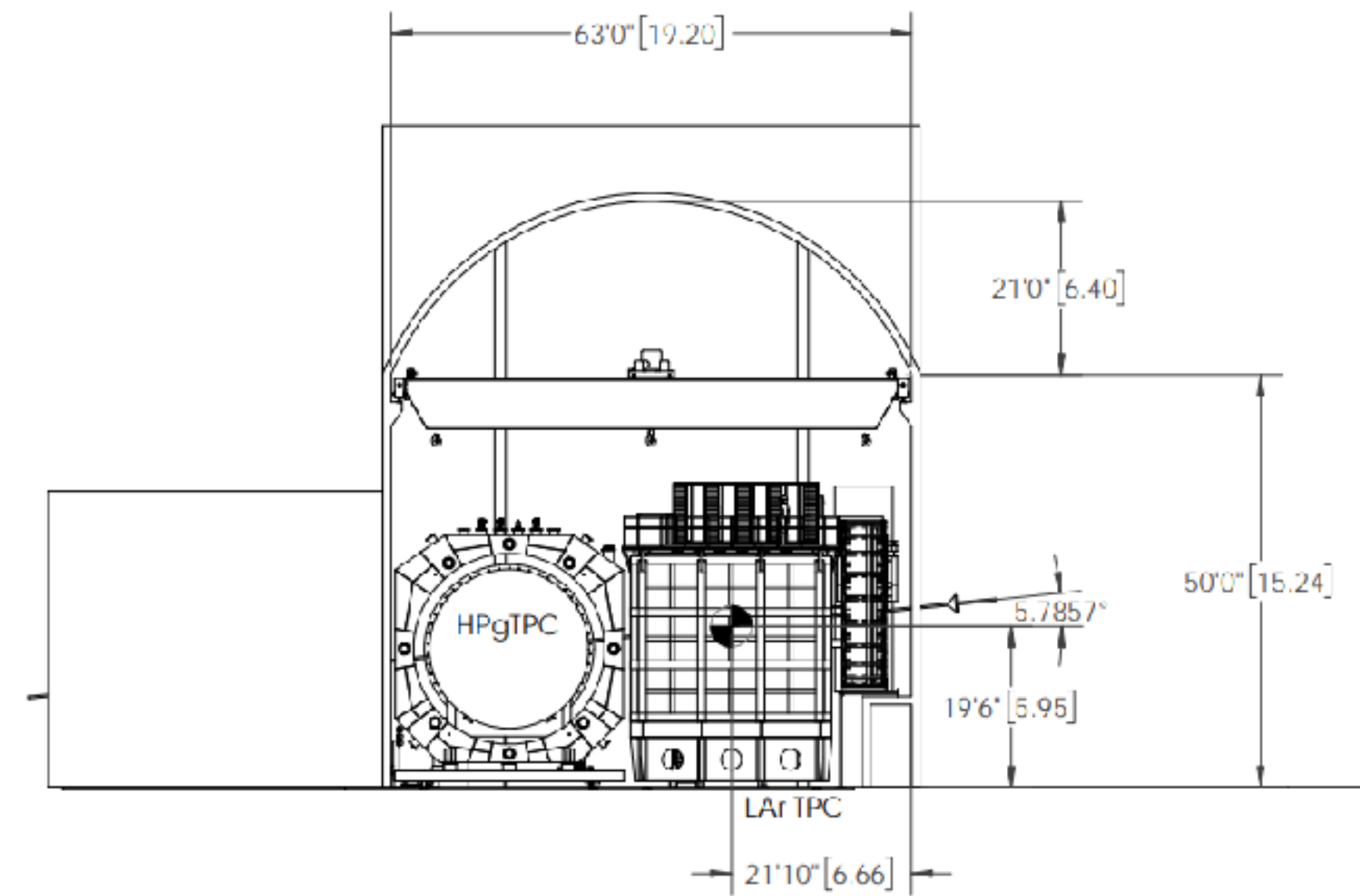
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DESY, 23rd October 2019

Muon system requirements.

Space and tagging

- Space for the MPD is limited
  - Need to fit after the ECAL and/or between the super-conducting coils
- Primary role
  - Help to identify muons from pions
- Other possible roles
  - Shower containment
  - Return Yoke
- Needs
  - Need to stop all pions (~4 lambdas)
  - Compact
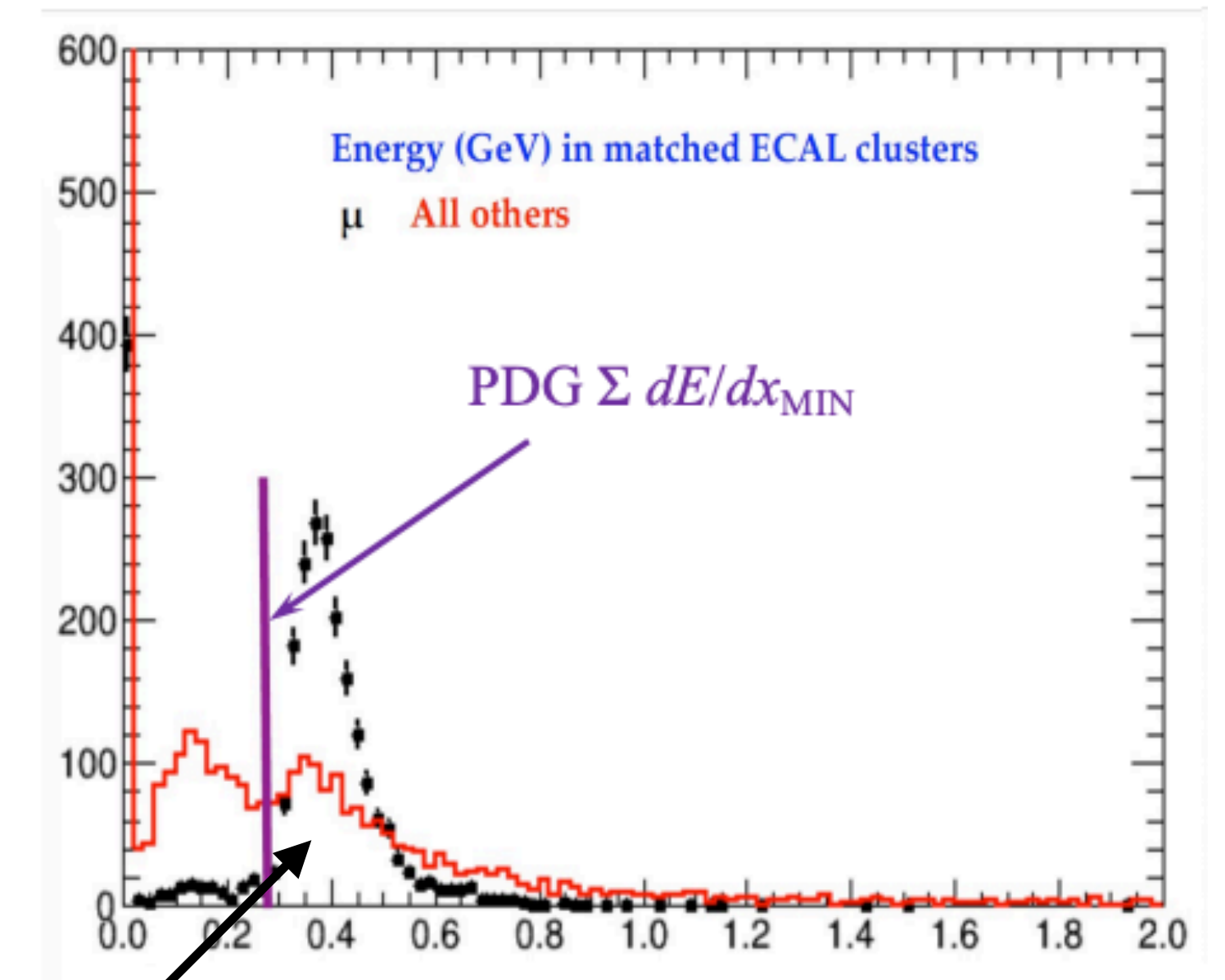 - Fast? Timing?
  - Granularity?

Current MPD System.
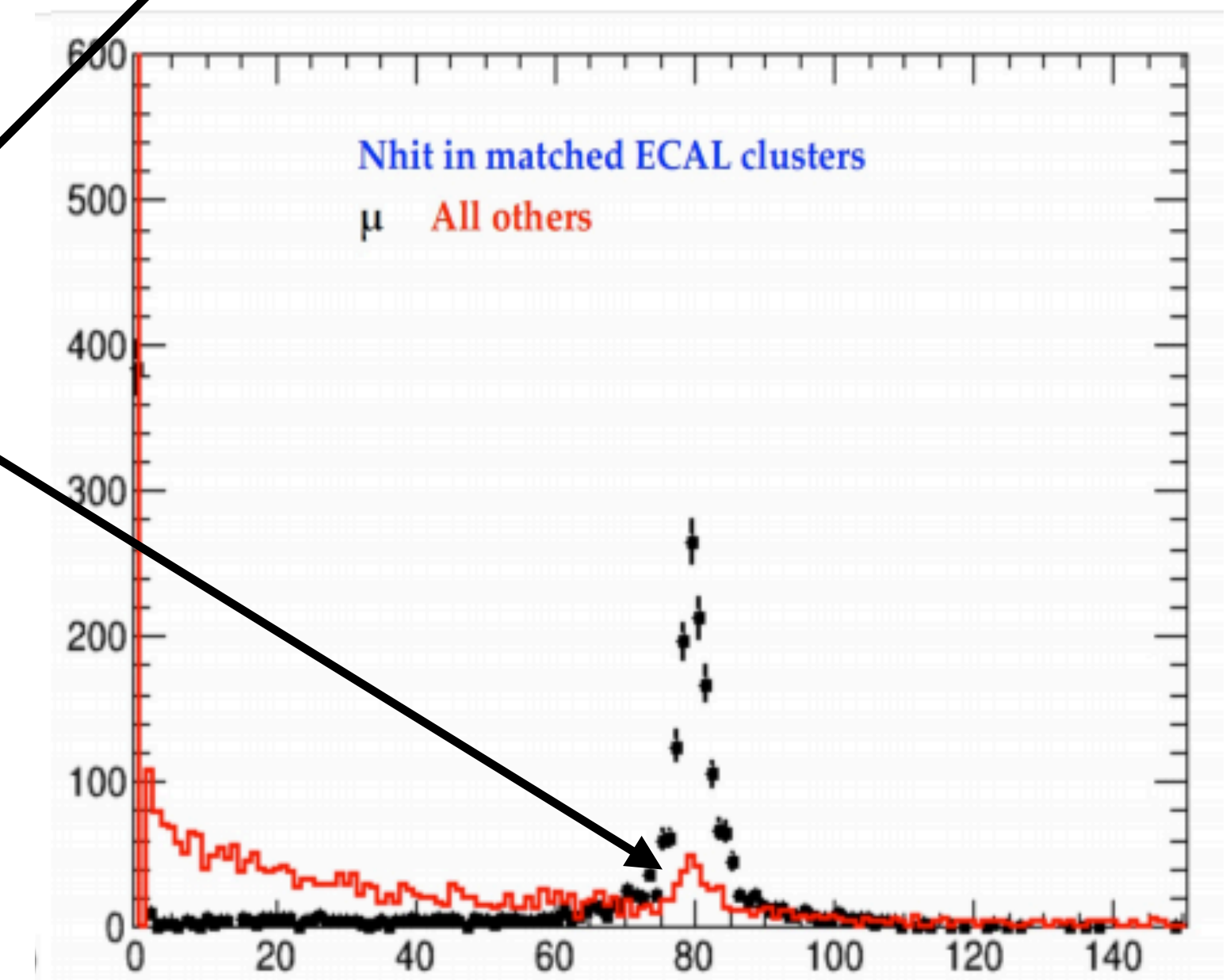## ECAL as a muon tagger

- Current design

  - ECAL is around 1 lambda

  - -> ~ 33% of pions will go through! Large signal contamination. Clearly not ideal

- Design of the ECAL to fulfil partially this role

  - Last 2 layers made of large lead slabs (~10 cm) with scintillator strips
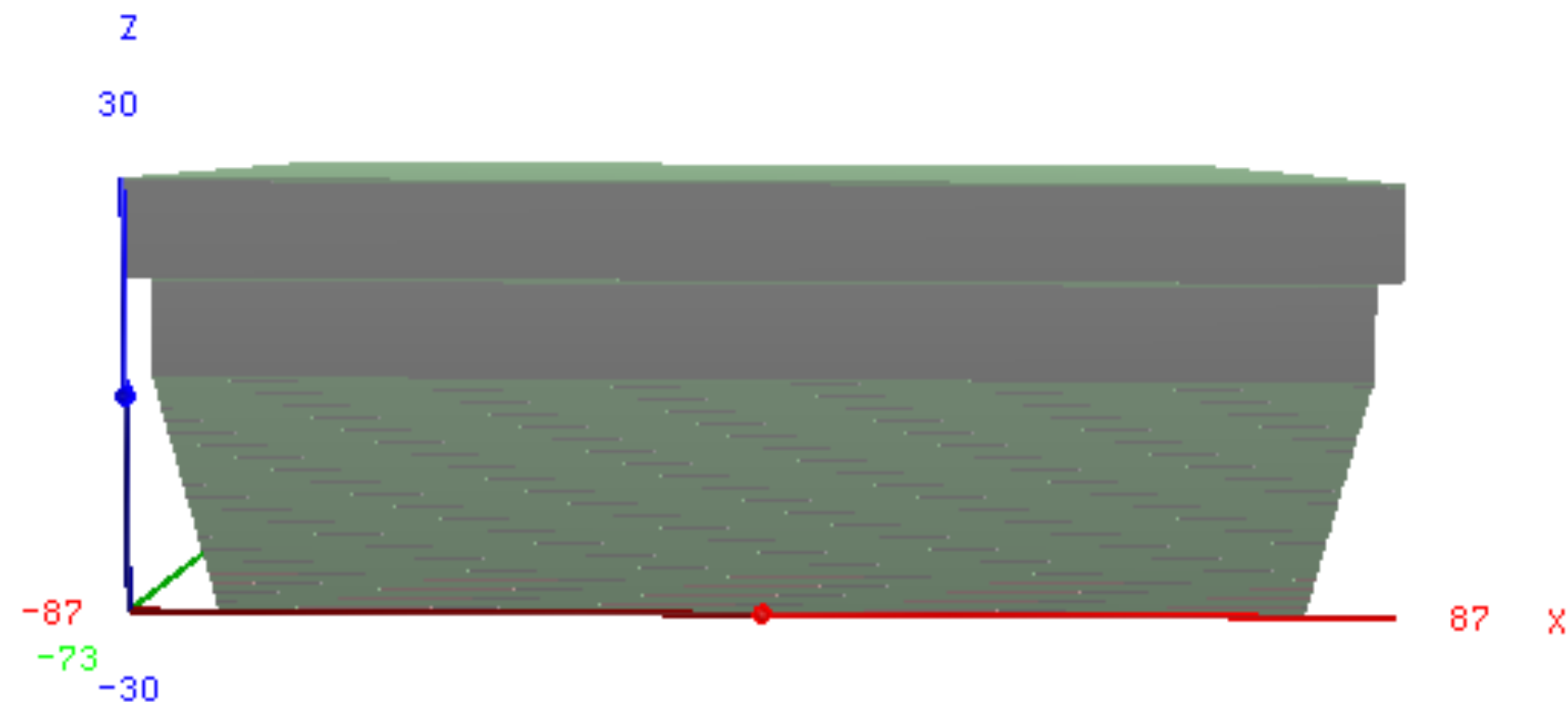

Pion contamination!

Design ideas/requirements.
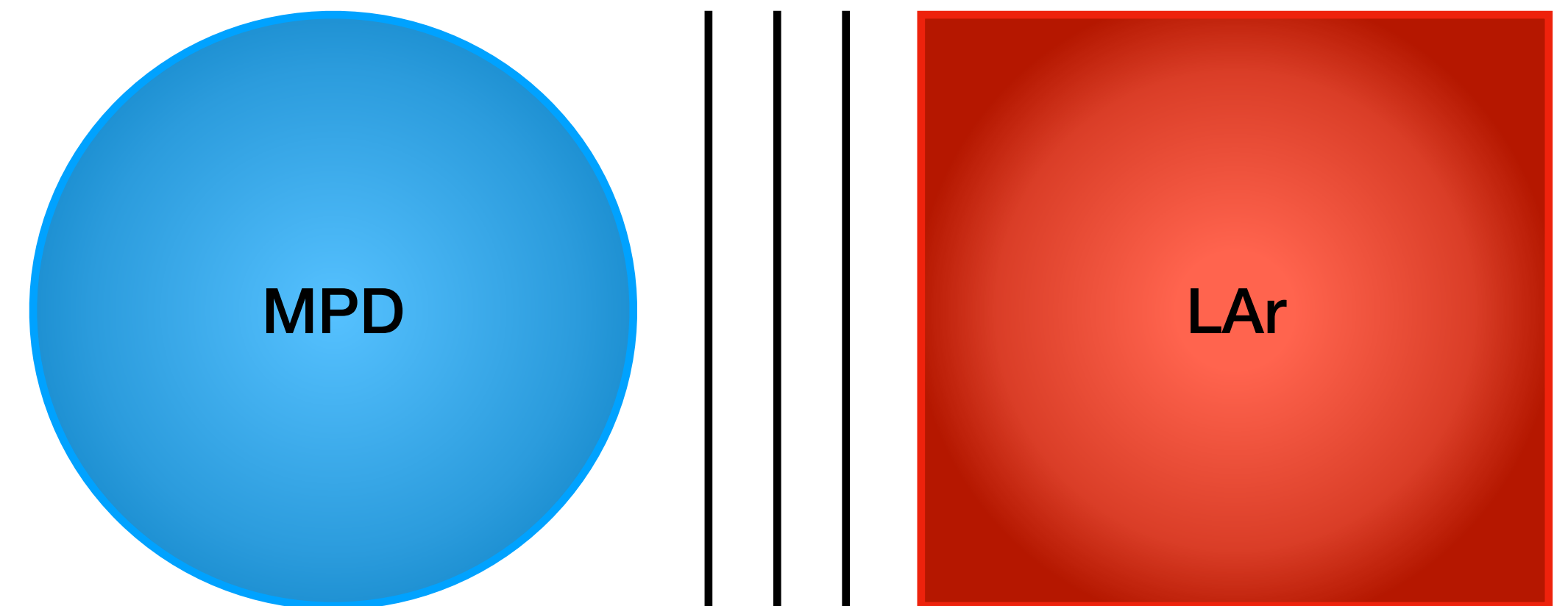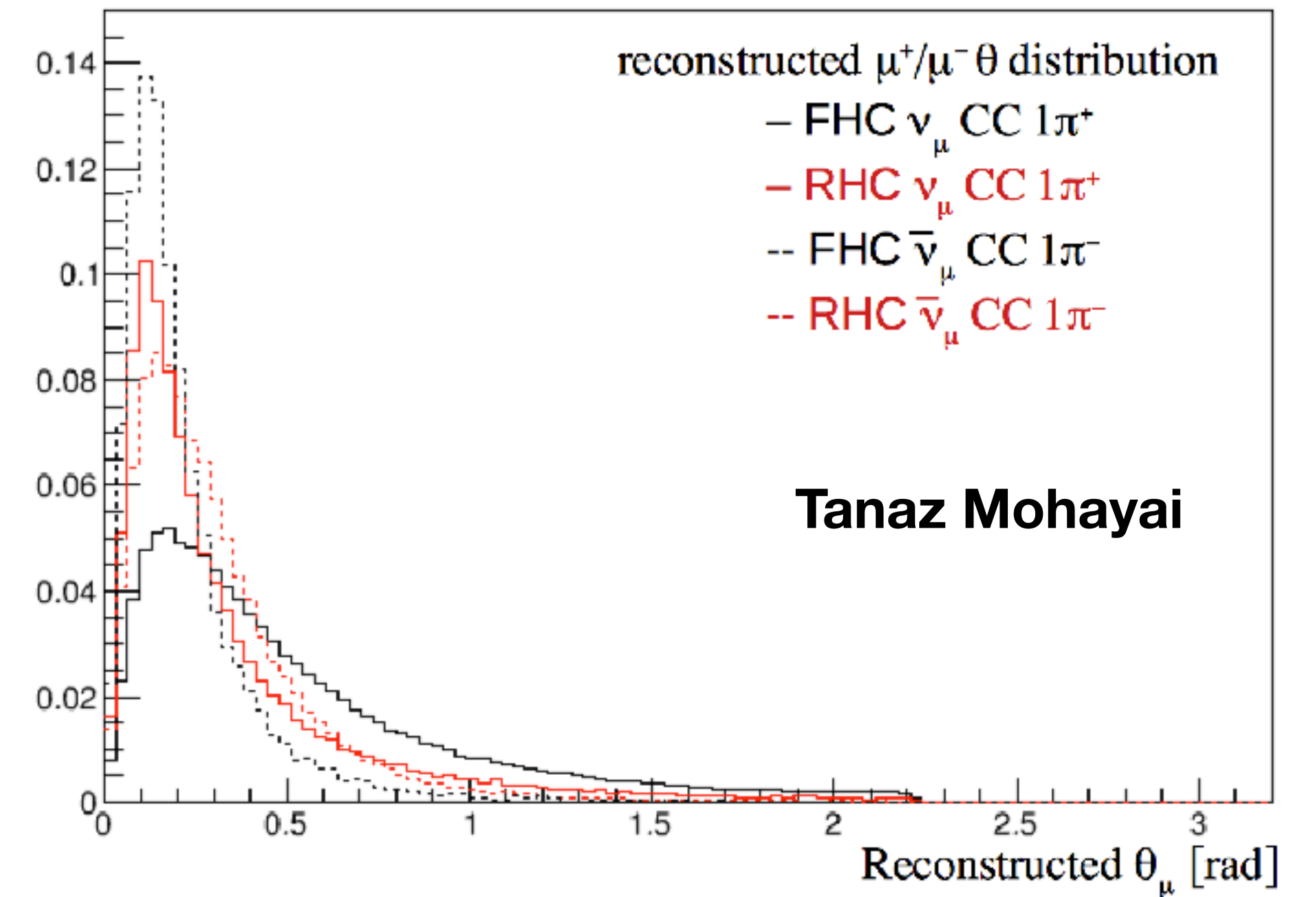
Simplistic muon tagger

- Simplistic design
  - Large slabs of lead/iron/brass interleaved with scintillator strips
  - Fiber(less)
  - Readout SiPM/PMTs on both sides
- Needs to be ~3 lambda thick (98% of pions will interact)
  - -> ~ 60 cm
  - Very limited space after ECAL and between the magnet coils
- Very good MIP efficiency (light collection efficiency, uniformity)
- Timing requirement?
  - ~ ns scale? Bkg reduction?
- Energy loss in iron ~ 11 MeV/cm
  - -> muons below ~600 MeV will range out
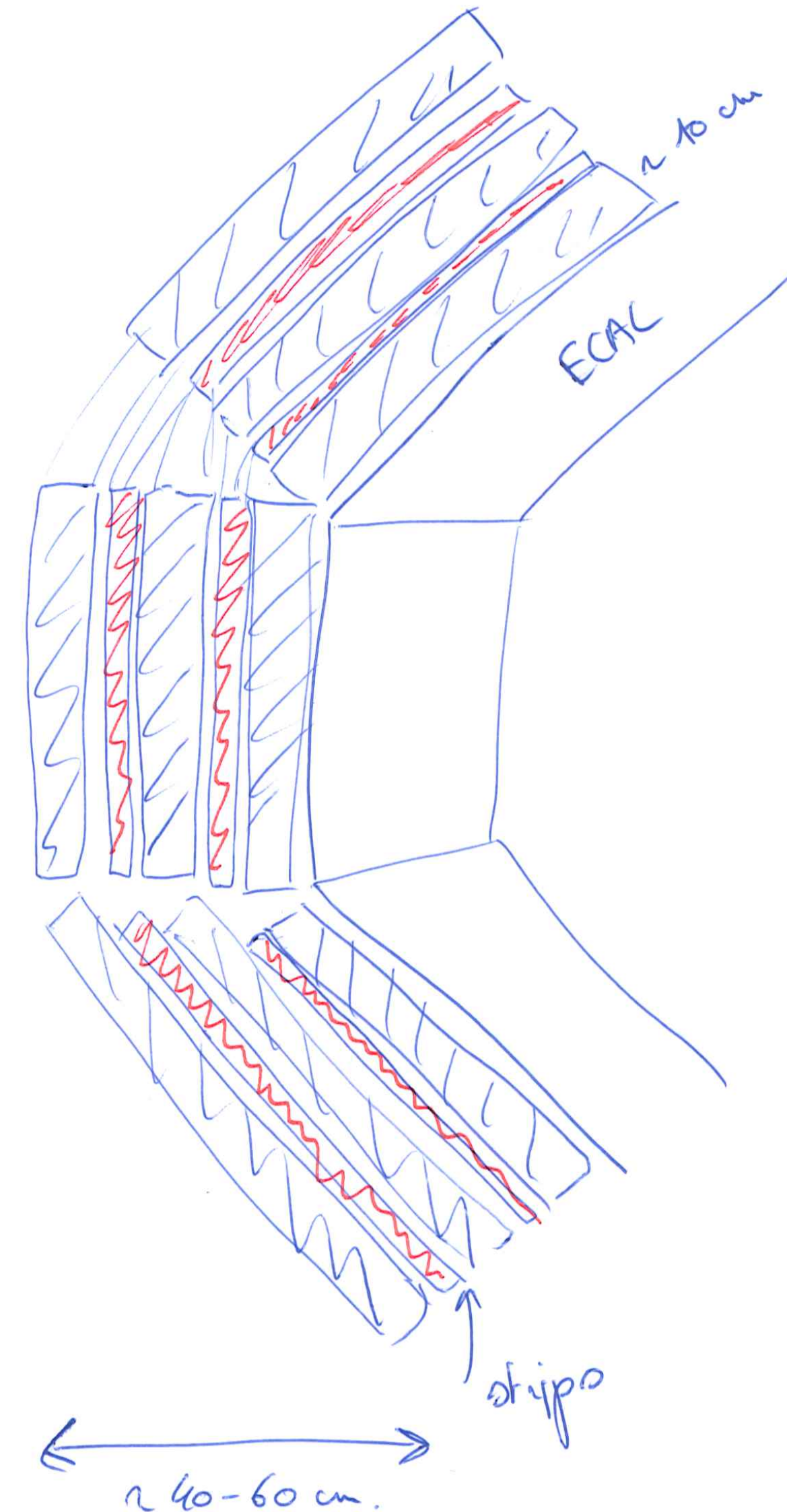
Design ideas/requirements.
Simplistic muon tagger

- Maybe only downstream (avoid too much background)

  - Needs to cover large enough acceptance

    - -> up to ~ 130 deg for all

    - up to ~90 deg will cover most part

- Upstream

  - Option for couple (timing) layers between the MPD/LAr to help with track-matching

    - Limited by the space between both detector

reconstructed μ^+/μ^- θ distribution
- FHC ν_μ CC $1\pi^+$
- RHC ν_μ CC $1\pi^+$
-- FHC $\bar{\nu}_\mu$ CC $1\pi^-$
-- RHC $\bar{\nu}_\mu$ CC $1\pi^-$

Tanaz Mohayai

Reconstructed θ_μ [rad]

MPD

LAr

Backup Slides.